MISSOURI DEPARTMENT OF TRANSPORTATION
MATERIALS
Jefferson City, Missouri
Test Method
MODOT T 71
DELETERIOUS CONTENT OF AGGREGATE

1.0 SCOPE. This test method describes procedures for determining the deleterious content of fine and coarse aggregates.

2.0 APPARATUS.

2.1 Containers of such a size and shape to contain the sample.

2.2 Sieves - No. 4 [4.75 mm].and No. 16 [1.18 mm].

2.3 Water to wet particles for observation.

2.4 Balance sensitive to within 0.5 percent of the weight [mass] of sample to be weighed.

3.0 PROCEDURE FOR COARSE AGGREGATE DELETERIOUS.

3.1 Preparation. The sample shall be tested in an "as obtained" condition. The obtained sample shall be sieved over a No. 4 [4.75 mm] sieve, discarding the material passing the sieve. The material retained shall be the test sample used to determine the deleterious content.

3.2 Sample Size. Recommended minimum test sample sizes of plus No. 4 [4.75 mm] material are as follows:

Maximum Size (1)		Sample Size
(inches)	[mm]	(grams)
2	50	10,000
1-1/2	37.5	9,000
1	25.0	5,000
3/4	19.0	3,000
1/2	12.5	2,000
3/8	9.5	1,000

(1) Maximum size is defined as the smallest sieve through which 100 percent of the material will pass.

3.3 Test. Each individual particle comprising the sample shall be examined piece by piece and separated into the various constituents as required by the specifications and in accordance with the descriptions shown in Section 7. The sample may be rinsed at the time of examination but shall not be soaked in water. Material not considered deleterious may be discarded except as needed for review. Each deleterious constituent shall be weighed, and the weight recorded. In some instances when required by the specification, the constituents are to be combined prior to weighing.

4.0 PROCEDURE FOR FINE AGGREGATE DELETERIOUS.

4.1 Lightweight [Low Mass Density] Particle Content including Coal and Lignite. The test shall be in accordance with AASHTO T 113, however lightweight [low mass density] sand particles are not considered deleterious lightweight [low mass density] particles.

4.2 Percent Other Deleterious Substances, Clay Lumps and Shale in Fine Aggregate.

4.2.1 Preparation. Recommended test sample size is approximately 200 grams, before sample is sieved over the No. 16 sieve.

4.2.2 Sample Size. The sample shall be tested in a dry condition (dried to a constant weight). Sample shall be sieved over a No. 16 sieve, discarding material passing the sieve. The material retained shall be the test sample used to determine the clay lumps and shale.

4.2.3 Procedure. The test sample shall be visually examined for shale, clay lumps and other deleterious substances. Particles may be lightly rinsed at the time of examination, but shall not be soaked in water. The deleterious substances shall be separated out into the constituents required by specification.

Shale is determined by using a non-glazed ceramic bowl (Plastic Index bowl). If particles leave a black mark on the bowl when pressure is applied to the material while moving it across the bottom of the bowl, this material is considered shale.

5.0 CALCULATIONS FOR DELETERIOUS CONTENT. The percentage of a deleterious substance shall be calculated as follows:

$$P = \frac{C}{W} \times 100$$

Where:

P = Percentage of each deleterious substance component.
C = Actual weight [mass] of deleterious substance for that component.
W = Weight [mass] of test sample for the portion retained on the No. 4 sieve

6.0 REPORTS. Report the percent deleterious obtained for each constituent required by specification, to the nearest tenth (0.1).

7.0 DELETERIOUS DEFINITIONS. The definition of deleterious material varies with the intended use and the anticipated affect on the final product.

7.1 For coarse aggregate for portland cement concrete (Specification Sec 1005), the following definitions apply:

7.1.1 Deleterious Rock. Deleterious rock includes the following material:

(1) Shaly rock. A rock that is generally contaminated with shale to a high degree. Color may vary but the rock usually has a dull gray appearance and is reasonably uniform in appearance. Also may occur in the form of numerous shale lines or seams closely spaced throughout the particle, thus giving a laminated or streaked appearance.

(2) Cap plus 20 percent. A rock particle with a line of demarcation of a layer or “cap” of shale

or shaly rock which usually occurs on one face, but may be found on two faces; in either case, the summation of the percent of “caps” exceeds 20 percent of the volume of the rock particle.

(3) Extremely soft and/or porous rock. A rock which can be readily broken with the fingers. In some cases, due to the size or shape of the rock it cannot be broken, however, small areas can be spalled or chipped off with the fingers. Porosity or high absorption may be detected by rapid disappearance of surface water or by breaking rock in half and observing the depth of penetration of moisture.

7.1.2 Shale. A fine-grained rock formed by the consolidation of clay, mud, or silt; generally having a finely stratified or laminated structure.

7.1.3 Chert in Limestone. A fine-grained rock consisting of silica minerals, sharp-edged and may be highly absorptive. May occur in the form of nodules, lenses, or layers in limestone formations; and may vary in color from white to black. Quartz-type material is excluded.

7.1.4 Other Foreign Material. Clay lumps, mud balls, lignite, coal, roots, sticks, and other foreign material not related to the inherent material being inspected.

7.2 For coarse aggregate for asphaltic concrete, plant mix bituminous pavement, plant mix bituminous leveling and seal coats (Specification Sec 1002 and 1003), the following definitions apply.

7.2.1 Deleterious Rock. Deleterious rock includes the following materials:

(1) Shaly rock. A rock that is generally contaminated with shale to a high degree. Color may vary but the rock usually has a dull gray appearance and is reasonably uniform in appearance. Also may occur in the form of numerous shale lines or seams closely spaced throughout the particle, thus giving a laminated or streaked appearance.

(2) Cap plus 20 percent. A rock particle with a line of demarcation of a layer or "cap" of shale or shaly rock which usually occurs on one face, but may be found on two faces; in either case the summation of percent of "caps" exceeds 20 percent of the volume of the rock particle.

(3) Extremely soft rock. A rock which can be readily broken with the fingers. In some cases, due to size or shape of the rock it cannot be broken, however, small areas can be spalled or chipped off with the fingers.

(4) Chert. Chert which is soft and highly absorptive is considered deleterious.

7.2.2 Shale. A fine-grained rock formed by the consolidation of clay, mud, or silt; generally having a finely stratified or laminated structure.

7.2.3 Other Foreign Material. Clay lumps, mud balls, lignite, coal, roots, sticks, and other foreign material not related to the inherent material being inspected.

7.3 For coarse aggregate for bituminous surface and plant mix bituminous base (Specification Sec 1004), the following definitions apply:

7.3.1 Deleterious Rock. Deleterious rock includes the following materials:

(1) Shaly rock. A rock that is generally contaminated with shale to a high degree. Color may vary, but the rock usually has a dull gray appearance and is reasonably uniform in appearance. Pieces of rock having shaly seams, skin shale, and pieces of rock which are not predominantly shaly are not to be considered as deleterious.

(2) Extremely soft rock. A rock which can be readily broken with fingers, or from which small areas can be spalled or chipped off readily with the fingers.

7.3.2 Shale. A fine grained rock formed by the consolidation of clay, mud, or silt; generally having a finely stratified or laminated structure.

7.3.3 Mud balls. Balls of mud.

7.3.4 Clay. A clay material which is more or less uniformly dispersed throughout the produced product.

7.3.5 Other Foreign Material. Any material not related to the inherent material being inspected.

7.4 For coarse aggregate for surfacing (Specification Sec 1006), the following definitions apply:

7.4.1 Deleterious Rock. Deleterious rock includes the following materials:

(1) Extremely soft rock. A rock which can be readily broken or spalled with the fingers.

7.4.2 Shale. A fine-grained rock formed by the consolidation of clay, mud, or silt; generally having a finely stratified or laminated structure.

7.4.3 Mud Balls. Balls of mud.

7.4.4 Other Foreign Material. Any material not related to the inherent material being inspected.

7.5 For coarse aggregate for base (Specification Sec 1007), the following definitions apply:

7.5.1 Deleterious Rock. Deleterious rock includes the following materials:

(1) Extremely soft rock. A rock which can be readily broken or spalled with the fingers.

7.5.2 Shale. A fine-grained rock formed by the consolidated of clay, mud, or silt; generally having a finely stratified or laminated structure.

7.5.3 Mud Balls. Balls of mud.